MP = -6.65 - 33A H 10.90-5=5.9 L 3.51-(-1)=4.51 3 H 8.28-5 = 5.28 L 6.59-(-1) = 7.59 MP = 6.76

135404

Average ΔH = 5.32'

MLT = -1
MHT = +5

5.2 Discharge through the Marsh Deposit

Darcy's law describes flow through porous media.

$$Q = kia$$

where,

Q = volume discharged in gallons per day

k = average permeability for the marsh deposit under the river

Data in Appendix B suggests a typical marsh deposit permeability of 1.8×10^{-3} ft/day (6.26×10^{-7} cm/sec).

The hydraulic gradient is calculated based on well cluster SM-3. Water levels in SM-3F and SM-3C were 7.55 feet MSL and 10.36 feet MSL, respectively, at high tide. The midpoints of each well screen are 63 and 17 feet, respectively. Therefore, the gradient (i) is

5.32' / 10 = .532' = i

$$i = (10.36\ feet\ MSL - 7.55\ feet\ MSL) / 63' - 17' = 0.06$$

The cross section area, a, is

$$a = 1{,}200\ feet \times 300\ feet = 360{,}000\ square\ feet$$

(2000)(300)(

Therefore,

.532 (300)(2000)

$$Q = (1.8 \times 10^{-3}\ ft/day)(0.06)(360{,}000\ ft^2)$$
$$= 39\ ft^3\ per\ day$$ = 574
$$= 290\ gallons\ per\ day$$ = 4303 gal/day

5.3 Columbia Aquifer Groundwater Quality

Data collected for the groundwater discharge assessment in March 1996 included Columbia aquifer samples. Dissolved metals results from that sampling event (see Appendix E) are tabulated as follows.

COLUMBIA GROUNDWATER QUALITY DISSOLVED METALS LEVELS (ug/L)			
Well	Zinc	Cadmium	Lead
MW-1B	26	<2.6	<1.7
MW-2B	5,990	57	<1.7
MW-33B(R)	25,600	421	<1.7
WM-33C	14,700	247	<1.7
SM-3C	30,400	156	<1.7
Average	**15,340**	**177**	**<1.7**

The average values represent groundwater that is migrating through the marsh deposit to the Christina River.

5.4 River Protection Factor

A low-flow condition of 1,000,000 gpd is estimated for the Christina River base flow. DERS has not been able to validate the river flow value. However, DERS believes that ongoing discussions with the Department of Natural Resources and Environmental Control (DNREC) will confirm the conservative nature of the number. The river protection factor (PF) is calculated by dividing riverwater flow by the flow from the Columbia Formation.

$$PF = 1{,}000{,}000\ gpd/290\ gpd \approx 3450$$

/4303 ≈ 232

Using the average concentration for total zinc, cadmium, and lead, the contribution of metals to this river can be calculated and compared to the protective concentration.

CONTRIBUTION OF COLUMBIA AQUIFER TO RIVER METALS LEVELS			
Metal	Average Dissolved Concentration (µg/l)	Incremental Contribution (µg/l)	AWQC (µg/l)
Zn	15,340	4.4 (66	120
Cd	177	0.051 .76	4
Pb	<1.7	0.00049	15

.0073

This assessment shows that the incremental loading to the river is 27 to 30,000 times less than the respective water-quality standard. Contamination in the Columbia does not impact river quality, and a short vertical barrier with no Columbia pumping is protective of the river.

6.0 PROPOSED LONG-TERM GROUNDWATER MONITORING PLAN MODIFICATION

To monitor the continued effectiveness of natural attenuation mechanisms, changes to the long-term groundwater monitoring (LTGM) program are proposed.

Section 7.3 of the ROD mandates a LTGM program to ensure the validity of the groundwater remediation waiver. Since DuPont has demonstrated that the Columbia Formation groundwater beneath the North Landfill area is flowing under the river toward Old Airport Road and not discharging in significant quantity to the river, this new groundwater pathway in the area of the South Landfill should be monitored. While well MW-6A is well positioned to monitor the Columbia groundwater (see Figure 2), it is relatively far downgradient. DuPont proposes adding a new well in the South Wetlands area, fully screened in the Columbia. The position of the screen is shown conceptually on Figure 2. The exact location will be determined in the field, based on access considerations. If the levels of constituents of concern rise significantly at some time in the future, a more detailed assessment of migration mechanisms might be warranted.

In addition, one of the primary purposes of the LTGM program is to monitor groundwater quality on the southern boundary of the site in both the Columbia and Potomac Formations. MW-21A is screened in the marsh deposit and not the Columbia, as originally stated in the RI (see cross-section B-B', Figure 5, and the boring log in Appendix C). It should be dropped from the program and a new well installed in the small strip of land between the James Street bridge and the Route 141 bridge, on the south side of the river bank. This new well would be screened in the Columbia and, in fact, be directly downgradient from the plant area.

MW-21B, which was assumed to be in the Potomac, is actually screened in the Columbia. Given the access problem to this location (as previously discussed with EPA), DuPont proposes dropping MW-21B and relying on well MW-18B as the Potomac monitoring point. It is also more directly downgradient from the plant area than MW-21B.

Table 4

COLUMBIA AQUIFER ASSESSMENT AND SITEWIDE HYDROLOGICAL CONCEPTUAL MODEL
GROUNDWATER QUALITY DATA[4]
Newport Superfund Site
Newport, Delaware

Parameter	Maximum Contaminant Levels (MCL's) or Secondary Drinking Water Standards MCL's	Columbia Aquifer Wells									
		SM-3C		MW-33B		MW-33C		MW-1B		MW-2B	
		RD/RA 3/96	PHASE III RI 11/90	RD/RA 3/96	PHASE III RI 11/90	RD/RA 3/96	PHASE III RI 11/90	RD/RA 3/96	PHASE III RI 11/90	RD/RA 3/96	PHASE III RI 11/90
General Chemistry Field Parameters[1]											
Temperature (degrees F)	N/A	54.00	NA	59.00	NA	51.00	NA	51.00	NA	53.00	NA
pH	N/A	5.64	NA	5.30	NA	6.06	NA	5.81	NA	5.17	NA
Specific Conductivity (micro mhos)	N/A	336.00	NA	239.00	NA	195.00	NA	95.00	NA	136.00	NA
Dissolved O2 (µg/l)	N/A	3.60	NA	10.10	NA	7.30	NA	7.20	NA	4.60	NA
Redox (mv)	N/A	189.40	NA	231.90	NA	221.20	NA	202.80	NA	250.10	NA
CO2 (mg/l)	N/A	66.00	NA	58.00	NA	51.00	NA	8.00	NA	20.00	NA
Organic Compounds											
Tetrachloroethene (µg/l)	5	6.00	NA	38.00	56.00	14.00	32.00	420.00	3.00	2.00	1.00
Trichloroethene (µg/l)	5	2.00	NA	8.00	12.00	4.00	10.00	15.00	ND	ND	ND
Vinyl Chloride (µg/l)	2	ND	NA	ND	NA	ND	NA	ND	NA	ND	
Inorganic Compounds											
Arsenic (µg/l)	50	ND	NA	ND	3.90	ND	[5]	ND	ND	ND	ND
Cadmium (µg/l)	5	166.00	NA	441.00	378.00	272.00	358.00	ND	ND	59.00	78.69
Chromium (µg/l)	100	ND	NA	58.00	ND	ND	ND	ND	ND	ND	ND
Copper (µg/l)	1,300 [2]	16.00	NA	5.90	7.20	8.20	15.40	5.90	10.80	34.00	44.79
Lead (µg/l)	15 [3]	2.80	NA	ND	ND	2.10	ND	ND	ND	ND	ND
Mercury (µg/l)	2	ND	NA	ND	NA	ND	NA	ND	NA	ND	
Nickel (µg/l)	100	136.00	NA	146.00	83.00	67.00	62.20	ND	ND	41.00	51.20
Zinc (µg/l)	5,000 [2]	30400.00	NA	26300.00	26100.00	15400.00	22000.00	28.00	42.40	6100.00	8290.00
Barium (µg/l)	2,000	430.00	NA	140.00	153.00	93.00	45.09	100.00	64.80	57.00	46.40
Cobalt (µg/l)	NA	117.00	NA	30.50	33.40	27.60	33.70	ND	ND	38.90	72.00
Magnesium (µg/l)	NA	9410.00	NA	4660.00	6130.00	4360.00	4740.00	1940.00	2360.00	3470.00	4660.00
Vanadium (µg/l)	NA	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND

[1] No parameter data available for Phase III RI samples
[2] Secondary MCL
[3] Lead action level
[4] Total Metals data shown. Dissolved metals data found in Appendix E.
[5] No Arsenic analysis for MW-33C in Phase III RI data
NA = Not analyzed